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Economics of Smallholder Animal Husbandry in Lalitpur District of Nepal

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Abstract

Livestock farming which contributes 11 percent of the total GDP and 32 percent of agriculture GDP is mostly managed by farm household and small enterprise in Nepal. The study aims to analyze the economic rationale of livestock holding using the benefit-cost ratio of livestock farming by the household level and to assess the determinants of dairy cattle herd size in small farm households. The study was conducted in Dalchoki, a ward of Konjyosom rural municipality of Lalitpur district in the months of October and November, 2016. Structured questionnaires were used to collect data from 178 households using census method following the inclusion criteria as least five goat or a cow or a buffalo. Cost items included feeding cost, livestock purchasing cost, labour cost, insemination, veterinary cost, shed and equipment cost whereas benefit items consisted value of milk, live animal and meat and egg, draught power, value of manure among others. Linear regression was employed to examine the determinants of dairy cattle herd size. The results showed positive net benefit from animal husbandry with labor cost excluded and negative net benefit with labour cost included. The regression results showed that landholding size, remittance, net benefit, ethnicity and economically active family members have positive effect in determining size of the number of dairy cattle.

Keywords: *Economics of livestock farming, cost benefit analysis, regression analysis*
JEL classification: Q1, Q12

1. INTRODUCTION

Agriculture serves as the primary economic foundation for numerous developing countries, Nepal included, as it is the most accessible resource (land and labour) to work with, fulfills essential human needs, supplies basic inputs for industries, and generates surpluses for export. Although the contribution of the agriculture, forestry, and fishing sector to the GDP has been gradually decreasing, it still accounted for 26.21% in the fiscal year 2019/20 (MOF, 2021).

About 40% of the agricultural GDP is contributed by livestock production (FAO, 2018) and more than 600 million households depend on the livestock sector as an essential source of income generation (FAO, 2020). In Nepal, where 83% of the population resides in rural areas, agriculture and livestock farming serve as the primary occupations. This sector is a crucial contributor to the country's economy, constituting 11% of Nepal's GDP, as reported by the Ministry of Livestock Development (2017).

Livestock Farming constitutes an integral facet of Nepal's agricultural sector, holding economic, social, cultural, and religious significance within Nepalese society. Domesticated animals commonly found in Nepal include buffalo, cow, yak, donkey, mule, sheep, goat, chicken, and duck. The terai and hilly regions primarily domesticate buffalo, cow, pig, chicken, and duck, while the mountainous areas focus on yak, sheep, goat, mule, and donkey. As of mid-March, FY 2020/21, there has been an increase in the population of livestock such as chickens, pigs, dairy cows, and buffaloes, while the numbers of rabbit, he-buffalo, yaks, and ducks have declined (MOF, 2021). Livestock serve various purposes, including the production of milk, meat, eggs, wool, skin, bone, biogas, organic manure, and labor. Major milk and milk product sources are buffalo, cow, and yak, while meat is primarily obtained from buffalo, sheep, goat, pig, chicken, and duck, the latter two also being sources of eggs. In the terai region, he-buffalo and oxen are utilized for cart pulling and ploughing, while in the hilly region, oxen are exclusively used for ploughing. In the mountain region, yaks, sheep, donkeys, and mules serve as essential means of transportation. Cow dung finds utility in rural areas for scrubbing floors and walls, and the various products derived from livestock, such as milk, meat, skin, wool, and bone, contribute as raw materials for diverse agro-based industries.

Among the 3.8 million farming households in Nepal, an impressive 95% engage in dairy farming due to its pivotal role in compost manure for agriculture, household nutrition, and providing draft power and local transport to some extent. However, the majority of households primarily produce for home consumption, with occasional sales during flush seasons. Merely 14% of milk-producing households (equivalent to 500,000) both produce and sell milk. The dairy sector not only creates employment opportunities for 130,000 people but also contributes significantly to Nepal's economy, constituting 9% of the country's GDP and 33% of its Agriculture GDP (CASA, 2020). The landscape of this sector is characterized by numerous small-scale subsistence farm households, micro and small collection-and-processing units, along with a limited number of large-scale industrial processing units.

The prevalent feature of subsistence-oriented agriculture in Nepal is the integration of crop farming and animal husbandry, creating a symbiotic relationship between the

two. Livestock manure enhances soil fertility, leading to improved crop production. Simultaneously, inedible plants and crop residues are repurposed into manure through animal feed, showcasing the mutually beneficial interaction between crop cultivation and animal husbandry.

In the Kathmandu Valley, Lalitpur exhibits a clear distinction between its northern and southern regions. The northern part is predominantly urban and densely populated, while the southern part is primarily rural, characterized by agricultural activities and small-scale livestock farming at the household level. The majority of people in southern Lalitpur are engaged in agriculture, with cattle rearing serving as a significant livelihood source. The hilly terrain in this region limits the scope for paddy cultivation, leading inhabitants to rely on alternative crops such as maize, mustard, barley, and millet. Livestock, including cows, buffaloes, and goats, are common in these areas, forming an integral part of the local agricultural landscape.

In the southern part of Lalitpur district, there exists one municipality and three rural municipalities, with two of them—Mahankal Rural Municipality and Bagmati Rural Municipality—bordering Makawanpur district, while Konjyosom Rural Municipality is entirely within Lalitpur district, surrounded by the aforementioned urban and rural municipalities. Within Konjyosom Rural Municipality, Dalchoki stands as one of the wards (specifically, ward 3) among its five wards. This area is characterized by sloping terrain, and a majority of its residents are actively involved in both agriculture and livestock farming. The synergy between agriculture and livestock plays a crucial role in ensuring food security, economic sustainability, and rural livelihoods. Livestock, including cattle, goats, and poultry, contribute to sustainable agriculture by providing valuable manure that enhances soil fertility and crop productivity. In turn, agricultural residues and by-products serve as essential feed for the animals, minimizing the reliance on external inputs. This cyclical relationship not only optimizes resource utilization but also diversifies income sources for smallholder farmers in the region.

Livestock rearing, although not without costs, involves both fixed and variable expenditures. Within animal husbandry, fixed costs encompass capital equipment, land, sheds, and implements, while variable costs consist of labor, feed, insemination, veterinary services, and miscellaneous items. The total cost of animal husbandry is the sum of these fixed and variable costs. In rural areas, individuals often exclude their own labor costs due to the low opportunity cost of labor, multitasking possibilities, and disaggregated time involvement. Additionally, costs related to self-produced green and dry crop residues, self-consumption of milk and meat, and the use of dung for manure and biogas are often not accounted for due to limited alternative uses. Despite being a significant local cultural and economic practice, many farmers are

unaware of their investments and returns in animal husbandry. This study focuses on exploring the economics of livestock keeping by examining the costs and benefits, as well as the factors influencing the number of livestock held by households.

The structure of this paper includes a section on related literature, followed by the methodology employed in the study. The penultimate section presents the results, succeeded by a discussion and conclusion of the study.

2. REVIEW OF LITERATURE

This section reviews available literature on smallholder livestock farming from various perspectives that this paper aims to examine.

Livestock Holding in Developing Countries

Pica-Ciamarra et al. (2015) conducted a household-level study across 12 developing countries to explore the role of livestock assets in the income of rural households. The findings indicated that a majority of households engaged in livestock keeping, with lower-income households more inclined to do so than their wealthier counterparts. However, the extremely impoverished faced challenges in investing in small animals due to limited resources. The study emphasized the need for customized policies regarding livestock, highlighting the importance of tailoring approaches to specific farming systems, livestock species, usage, and diverse wealth groups.

Pica-Ciamarra et al. (2011) conducted a study investigating the livestock asset positions and income contributions of rural households in 12 developing countries, including Nepal and various nations in Africa, Asia, and Central America. The findings revealed that, contrary to expectations, poorer households in rural areas were more likely to engage in livestock farming compared to wealthier counterparts. In the context of Nepal, while the gap in livestock holdings between rich and poor in rural areas is not extensive, there is a significant difference observed in urban households, where the poor maintain a higher number of livestock than the wealthy. Among the 12 countries studied, excluding Pakistan, rural households experiencing poverty were notably reliant on livestock farming.

Determinants of Livestock Holding among Smallholder Farmers

In a research endeavor by Duguma and Debsu (2019) involving 99 sampled households in Kebele, Ethiopia, various factors significantly impacted livestock holdings. The availability of grazing land, extension services, artificial insemination, veterinary services, market information, and the educational level of the household head emerged as significant variables. Interestingly, the educational level of household heads

exhibited a negative association with livestock holdings, a phenomenon attributed by the researchers to the potential impact of better education leading to the pursuit of new and higher-quality job opportunities. Conversely, the availability of grazing land, extension services, artificial insemination, veterinary services, and market information demonstrated a positive correlation with livestock holdings.

Benefit Cost Analysis of Livestock Farming

Fernandes et al. (2021) analyzed the costs and benefits of improving animal welfare. The study pointed out the major costs of any intervention of improving animal welfare are infrastructure costs, operational costs, costs contributed by businesses indirectly. Among these, one time infrastructure cost accrues huge amount. The authors also mentioned need of training to farmers to improve farm animal productivity. The study listed the benefit components of the intervention as benefits to animals, benefits to business, benefits to society. The study focused on the evaluation of cost and benefits of any intervention such that there is positive effect on animal and business.

A study of 5 small dairy farms from southern Romania, Popescu (2014) estimated the influence of labour and material costs on from milk and profitability. Authors used material cost which included feeding cost, replacing heifer, equipment and shed depreciation, electricity and water cost, fuel and lubricants cost, labour cost and income coming from milk. The Cobb-Douglas function was used to determine the variation of the studied economic indicators and relationships between them. The study found that the profitability was depended both on cost of inputs and milk output as well as market price of milk. In yet another study, Celik and Bayrmoglu (2010) analyzed the profitability of Angora goat breeding enterprises and indicated that the cause of decrease in angora goats was decrease in mohair prices. The study concluded that mohair was the main source of income in the years 1960 and 1970, but it became source of supplementary income as mohair price decreased.

In another study, Ng'ang'a et al. (2020) analyzed the cost and benefits of improved livestock (cattle, small ruminants, camels and poultry) management practices by agro-pastoralists in Oromia lowlands of Ethiopia. The improved management practices were deferred-rotation grazing, active restoration of degraded rangeland and fodder cultivation. Both financial and economic analysis was performed. The results showed that three improved management practices had positive net present values for the livestock producers at a 12 percent real discount rate financially as well as economically.

A study on milk production in Bihar of India by Singh et al. (2012) it was found that the dairy farming as an important source of livelihood, particularly on small holder households. The study found that producers were receiving 58% of the price paid

by the consumers in market for all categories of herd size since all were marketing through cooperatives. Production cost was found to decrease with size of units and in production of crossbred cows in herd.

In a wider study by FAO (2010) concluded that the production cost of milk rises due to grain-based fodder as well as lack of technology, training, commercialization and proper veterinary service. Study suggested to be focused on green grass-based fodder rather than grain-based fodder to lower the cost of dairy farming significantly. Genetically improved cattle and proper veterinary services could cause to decrease the cost in dairy farming.

Several studies have been conducted on this issue in Nepal too. In one study, Paudel (2015) examined the cost and benefit of milk production in Kanyam VDC of Illam district in 65 households adopting dairy farming with varied stall size from 1 cow to 5 cows. Study showed that cost components varied according to size of the stall and breed of the cow. The benefit cost ratio for all cows' stall was found greater than one which implied the net positive profits. However, two cows' stall was seemed to be of optimal stall size. In another study, Chaudhary and Upadhyaya (2013) conducted a study to analyze the socio-economic impact of dairy cooperative in Saptari district taking 224 responses from farmers. The major sources of income were recorded as main crop, cash crop, dairy farming and goat farming. Among them, dairy farming was the highest income contributor (55%) to the rural farmer.

In yet another study in Nepal, Thakur et al. (2003) studied the socioeconomic impact of goat farming in Bandipur. The study found that all the three categories of landless, marginal and small farmer were involved in goat farming for their sustainable income and gainful employment. The study showed that the benefit cost ratios on household having goat, buffalo and cattle were 2.78, 3.42, and 1.34 respectively which showed the profitability in animal husbandry.

Yonghang (2013) studied about the livestock based micro- enterprise and its effectiveness on poverty reduction in Hansposa VDC of Sunsari district covering 47 respondents. The study found that, the livestock based micro-enterprise had high importance in rural economy which provided food, employment and income generating opportunities. However, livestock rearing was still of subsistence in nature mainly due to the lack of systematic cultivation of fodder and forages, lack of the vaccination, low quality breed and high price of livestock feeds.

These studies show that socio-cultural and behavioural factors are important determinants of livestock keeping practices. There is a lack of studies that adequately

explain the economics of livestock keeping. Thus this study aims to fulfill this caveat in the context of rural community and households.

3. METHODOLOGY

This section provided a brief description of the area where study was conducted, sampling design, methods of data collection and the tools of analysis used in the study.

Study Area

Konjyosom rural municipality is one of the rural municipalities of Lalitpur district. Itlies in the southern region of Lalitpur district. Most of the part of this rural municipality are rural covered by forest areas which provided favorable environment for animal husbandry. Konjyosom rural municipality has 5 wards, namely Chaughare, Shankhu, Dalchoki, Nallu and Bhardeu. Dalchoki was purposively selected as a ward with large livestock practise. According to CBS (2011), Dalchoki DC has 269 households, most of them are involved in animal husbandry.

Sampling and Data

For the present study, 178 households involved in animal husbandry were selected i.e., total population of households involved in animal husbandry. This covers 66.17 % of the total households in Dalchoki. In this context, the purposive census method was used in the study with defined inclusion and exclusion criteria. The inclusion criterion was that the household should be keeping at least five goat or cow or buffalo. This was necessary to examine the economies of scale for policy making purpose. On the other hand, the exclusion criterion was not keeping cow or buffalo as well as keeping only less than five goats or few numbers of local poultry only.

For the data collection, interviews were conducted with household heads using structured questionnaire. The questionnaire consisted of household details of landholding, livestock holding, labour cost, cost of feeding materials, insemination cost, death of livestock, type of shed, equipment costs, production from livestock and products from animal husbandry. The survey was conducted in 2016.

Variables Used in the Study

Private cost and benefit of household were used in the study rather than social cost and benefit. Estimating social cost and benefit need additional efforts as they include externalities, diversities of stakeholders, time horizon and distributional effects. Private costs and benefits refer to the costs and benefits that accrue to individuals or private entities engaged in a particular economic activity, transaction, or decision. These are the costs and benefits directly experienced by the decision-maker and are not

necessarily shared with or considered by others in society. Since these farmers were mostly subsistence farmers, their livestock keeping were not specialized in a single livestock variety. Instead, they consisted of a wide variety of livestock including, for instance, units of poultry along with dairy cattle as an optimizing strategy (somewhat similar to mixed cropping or multi-tasking). This would allow households to reap multiple benefits at little extra cost of input and labour time. Thus, all the cost and benefits incurred from livestock keeping by households that fall in the inclusion criterion has been covered in the economic analysis.

Cost Variables

The cost components are feeding cost, livestock purchase, labour, insemination, veterinary and lost livestock as well as shed and farm equipment.

The feed costs have included the cost of grass, rice bran, maize, oil cake, salt and other feeding items. In study area farmers had preferred more for the grain-based feeding rather than green grass-based feed though cost of grain-based feeding was higher. Most of the farmers in study area had bought the lactating cow and buffalo rather than the non-lactating dairy cattle and other livestock.

The entire households in the study area had been using household labour for animal husbandry instead of hired labour. In this study, the labour cost for eight hours of laboring was taken as NPR 500 as suggested by focus group discussion with concerned stakeholders for regular job though the local prevailing daily wage for the labour force in the study area was found to be NPR 600 with two times meal a day for irregular jobs. Based on discussions, NPR 500 was considered appropriate as labour price for animal husbandry at homestead. It was because animal husbandry had provided the continuous employment for the household labors whereas there was near zero opportunity cost for other occupation in the study area for the most of the farmers.

Most of the farmers in the study area were having natural insemination to their livestock and few of them had also having artificial insemination to their livestock as well. The equipment like sickle, grass chopping machine, baskets, pots etc. had been used in animal husbandry.

Benefits Variables

Similarly, benefit components are, value of milk, livestock selling, meat and egg, draught power, manure and others.

In the study both the household consumption and selling quantity of milk have been taken and valued on the basis of prevailing market price at which farmers sell their products. This study includes value of both self-consumption and selling of live animals, meat and eggs with reference of prevailing local market price.

Bullocks are being used for the draught power. Likewise, buffalo, cow and bullock had been also used for the threshing purpose too. The value of their draught power is monetized equivalent to cost of tractor or human labour

Most of the farmers involved in animal husbandry had also involved in crop cultivation too. Thus, the manure had minimized the cost of chemical fertilizer for the farmers with reducing crop production cost simultaneously. In this study, the cost of a doko (basket) of manure had been taken as NPR. 50 as per focus group discussion with the concerned people in the study area. According to them, 3 doko of manure was equivalent to 50 kg of chicken manure. With reference to the prevailing market price, 50 kg of chicken manure had cost NPR. 110 and NPR 40 had to be paid for the transportation of manure, which showed total cost NPR 150 for 50 kg of chicken manure.

The others benefit from animal husbandry were income from ghee, natural insemination, biogas etc. in the study area.

Socioeconomic Variables

In addition, the socioeconomic determinants of livestock size are ethnicity, numbers of economically active family members, landholding size, education level and remittance earning. Eight types of different ethnic groups had inhabited in the study area. In this study, ethnicity has been taken as a dummy variable, where Brahmin/Chhetri = 1 and 0 for the other ethnic groups.

When the people have higher education level, they may have preferred to adopt other occupation than animal husbandry. For this 1 has been assigned for presence of higher-level education holder in family and 0 for presence of below higher-level education holder

Generally, when there is large number of economically active people in a family, livestock size also increases.

The manure produced from livestock has vital role in crop cultivation with reducing cost of chemical fertilizer and increasing the production of crops simultaneously. On

the other hand, forage and grain produced from crops are good source of feeding for the livestock too. Therefore, numbers of livestock size might have been affected due to landholding size.

Remittance earning have been the most common characteristics of Nepalese society, though it could affect either positively or negatively for the animal husbandry as well as numbers of livestock size. In one except, it can provide the capital for investment. On other hand, people can also prefer less for the animal husbandry due to alternative source of income. Thus, treating remittance earning as a dummy variable, 1 has been assigned for remittance receiving family and 0 for not remittance earning family of the study area.

Net Benefit

Net benefit from the animal husbandry is another determinant which affect the number of livestock. Net benefit has positive effect on the number of livestock possessed by households. Higher the benefit from animal husbandry, higher will be the motivation to keep the livestock.

Tools of Analysis

The inputs employed and benefits received were quantified in monetary term with reference of prevailing market prices. Net present value and benefit cost ratio were calculated to analyze the profitability of the animal husbandry.

a. Cost Benefit Analysis

To analyze the cost and benefit of animal husbandry sum of cost components, sum benefit components, net benefit as well as benefit cost ratio have been estimated in following ways:

Total Cost (TC) = C1+ C2+ C3+ C4+ C5 …… (1)
Total Benefit (TB) = B1 + B2+ B3+ B4+ B5 ……(2)
Net Benefit = TB -TC ……(3)
Benefit Cost Ratio = TB/ TC …….. (4)
Where,
C1= Feeding cost, C2= Livestock buying Cost, C3= Labour cost
C4= Insemination, veterinary and lost livestock cost, C5= Shed and equipment cost,
B1= Benefit from milk, B2= Benefit from livestock selling, meat and egg
B3= Benefit from draught power, B4= Benefit from manure, B5= Benefit from others
Net benefit and benefit cost ratio have been calculated with and without labour cost.

b. Model Specification for Determinants of Dairy Cattle Size

The ordinary least square model has been used as the linear regression model to analyze the socioeconomic determinants affecting the numbers of livestock size by the households. Thus, the linear regression model using the ordinary least square (OLS) technique is presented as follows:

$Y= a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + U$ …….. (5)

Where,

Y = No. of livestock (number of cows and buffalo)

a = Constant or intercept

b_is = Coefficient of explanatory variables

X_1 = Ethnicity (Brahmin/Chhhetri =1 or else, 0)

X_2 = No. of economically active family member

X_3 = Total landholding size in hectare

X_4 = Highest education level of household member (Dummy variable as higher education =1 or else 0)

X_5 = Remittance earning household (Dummy variable as remittance earning household =1, not earning = 0)

X_6= Net benefit received from animal husbandry excluding labour cost (in NPR. '0000)

U = Error term

4. RESULTS

a. Description of Respondents

Table 1 shows the description of respondents. Tamang, Brahmin, Magar and Pahari are the major ethnic groups in the study area. Most of the household heads were just literate and just 2.25 % had higher education.

Table 1: Description of Respondents

Variables	Categories	Frequency	Percentage	mean
Ethnicity	Brahmin/Chhetri (1)	47	26.40	0.26
	Others (0)	131	73.60	
Educational level of household head	below higher education (0)	174	97.75	0.02
	higher and above (1)	4	2.25	
Gender	Male (1)	152	85.39	0.85
	Female (0)	26	14.61	

Age group	16-30	11	6.18	48.56
	31-45	69	38.76	
	46-60	71	39.89	
	61-75	23	12.92	
	76 and above	4	2.25	
Remittance	recipient (1)	32	17.98	0.18
	non-recipient (0)	146	82.02	
Landholding (in hectare)	Less than 1	82	46.10	1.21
	1 to 1.99	62	34.70	
	2 to 2.99	29	16.30	
	3 to 3.99	4	2.20	
	4 and above	1	0.60	

Source: Household Survey, 2016

Out of 178 household heads 152 were male as well as 26 were female. In study area, the maximum age of household head was found to be 83 years and minimum age 22 years. There were 34 people of 32 households who had gone for the foreign employment. The average landholding of the household was 1.21 hectare (minimum 0.10 hectare and maximum 4.07 hectare).

b. Cost, Benefit and Net Benefit

In the study area, there were seven categories of herds on the basis of household having total numbers of livestock (i. e. cow and buffalo) present in their herd. These herds were the herds with total numbers of cow and buffalo 0, 1, 2, 3, 4, 5 and 6. Category 0 refers to those households who do not own any dairy cattle but raise at least 5 goats while category 6 was the largest dairy cattle size found in the study area. The average annual cost per household having different livestock size are explained below.

The average cost of livestock buying for the household having herd with total number of livestock 0 was found to be minimum with NPR 9047.62 and that for the household having livestock with total number of livestock 6 was found to be maximum with NPR 200000. The labour cost and feeding were found to be increased when the numbers of livestock increased in the herd. Most of the farmers were having natural insemination to their livestock but only few of them were having artificial insemination to their livestock.

Table 2: Average Annual Cost of Each Item for Categorized Herd Sizes (NRs.)

Livestock	Livestock Buying	Labour	Feed	Veterinary, Insemination and Lost Livestock	Shed and Equipment	Average Cost
0	9047.6	86263.8	21774.2	9148.1	9431.6	135665.4
1	29311.8	152044.4	50466.5	7158.3	14343.4	253324.4
2	61277.6	187638.5	78609.4	8441.0	17517.3	353483.9
3	103875.0	231829.2	114960.5	14445.8	41506.2	506616.8
4	129444.4	257916.7	199024.5	9722.2	41327.4	637435.3
5	66666.7	288274.0	199450.3	13833.3	30105.0	598329.2
6	200000.0	346597.9	200585.0	16900.0	36079.5	800162.4

Source: Household Survey, 2016

The annual average cost of veterinary, insemination and lost livestock for the household having herd with the total numbers of livestock 1 was found to be minimum and that of household having herd with the total numbers of livestock 6 was found to be maximum. The shedding cost was increased due to the earthquake in the year 2015. The shedding and equipment cost was found to be increased when the numbers of livestock increased in the herd. The average cost has increased according to the number of livestock in the herd except in household having herd with total numbers of livestock 5. Table 3 shows the average annual cost incurred in different components.

Table 3: Average Annual Cost with Cost Components (NRs.)

Cost Items	Mean	Percentage
Livestock purchasing	57575.8	16.7
Labour	179367.2	51.9
Feed	78922.8	22.8
Veterinary, Insemination and Lost Livestock	9264.8	2.7
Shed and Equipment	20617.3	6.0
Total Cost	345747.9	100.0

Source: Household Survey, 2016

Table 3 shows that labour cost had the highest share in total cost followed by feeding cost while cost of livestock buying, shed and equipment cost as well as cost of veterinary, insemination and lost livestock comes in the respective order. As a result, the average annual total cost for animal husbandry in the study area was found to be NPR. 345747.9.

Most of the household had used only the household labour for animal husbandry. The labour used in animal husbandry is a part of multitasking at household level and all the livestock activities are undertaken in leisure time with opportunity cost being almost nil. Few of the people have alternative source of employment and income. The annual average labour cost was deducted from annual average cost to obtain average cost excluding labour cost.

Table 4: Average Annual Cost Including and Excluding Labour

Livestock	Average Cost Including Labour Cost	Average Labour Cost	Average Cost Excluding Labour Cost
0	135665.4	86263.8	49401.5
1	253324.4	152044.4	101280.0
2	353483.9	187638.5	165845.3
3	506616.8	231829.2	274787.6
4	637435.3	257916.7	379518.6
5	598329.2	2882740.0	310055.3
6	800162.4	346597.9	453564.4

Source: Household Survey, 2016

Table 4 shows that annual average cost excluding labour cost was found to be decreased significantly because labour cost had occupied the highest share among the all cost components.

Table 5 shows the average benefits received by the households having different livestock size. The components of the benefits are shown in the table.

Table 5: Average Annual Benefit from Each Item for Categorized Herd Sizes

Livestock	Milk	Livestock Selling, Meat & Egg	Manure	Draught Power	Others	Average Benefit
0	0.0	35357.1	28244.1	5647.6	0.0	69248.8
1	125257.7	40670.6	44372.6	3341.2	2156.9	215798.8
2	236710.8	36039.2	58972.0	6546.3	3853.9	342122.1
3	336147.5	50293.8	79083.3	10275.0	8781.3	484580.8
4	494370.0	48194.4	92263.9	16000.0	4822.2	655650.6
5	462010.0	18366.7	109500.0	19466.7	8866.7	618210.0
6	527520.0	98783.3	127750.0	60600.0	9566.7	824220.0

Source: Household Survey, 2016

Milk produced from the cow and buffalo had the highest share in total benefit for the households in the study area except households having no cow and buffalo. It can be seen that there is an increase in income from milk while increase in numbers of livestock. The farmers are using their livestock for self-consumption of meat and egg as well as had been selling rest of meat and egg. Most of the farmers were using produced manure in their own field but few of them had also sold to the villagers. The benefit from the manure for the household was found to be increased as the numbers of livestock increased in the herd. Bullock were being used to plough the own field of farmer as well as for wage earning through ploughing villager's field. On the other hand, buffalo, cow and bullock were also being used for threshing. Other benefit includes the benefit from ghee, biogas, natural insemination etc.

It can be seen that the households having herd with the total numbers of livestock 0 had least income and that of the households having herd with the total numbers of livestock 6 had maximum income from animal husbandry among the all categories. The result reflects that the increase in income from animal husbandry while numbers of livestock increased in the herd.

Furthermore, average annual benefit received by a farmer in the study area was found as follows:

Table 6: Average Annual Benefit from Animal Husbandry

Items	Mean	Share in Total Benefit
Milk	211984.4	65.92
Livestock Selling, Meat & Egg	40581.88	12.62
Manure	57569.52	17.9
Draught Power	7631.46	2.37
Others	3807.08	1.18
Total Benefit	321574.3	100

Source: Household Survey, 2016

Hence, the benefit from the milk was found to be highest followed by benefit from manure, livestock selling, meat and egg, draught power and others.

As the numbers of livestock increased in the herd the patterns of the marginal cost and benefit were found as follows.

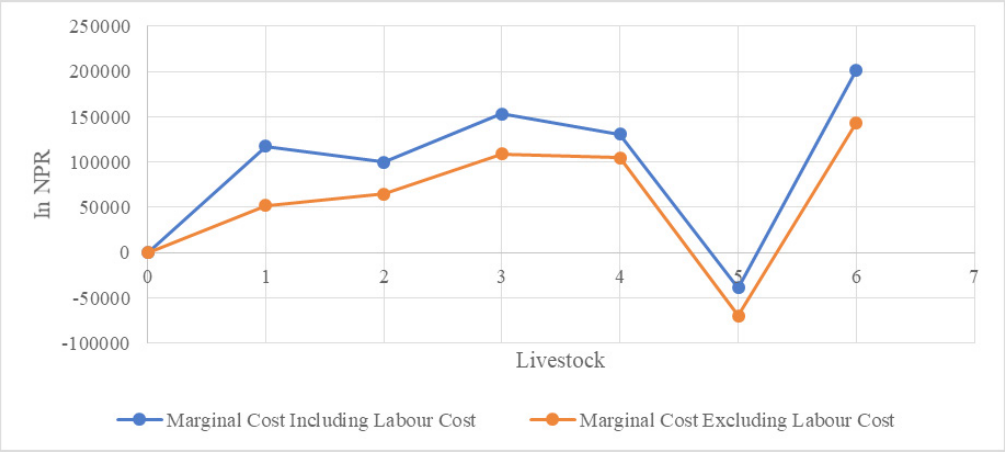
Table 7: Marginal Cost and Marginal Benefit by Herd Sizes

Livestock	Marginal Cost Including Labour Cost	Marginal Cost Excluding Labour Cost	Marginal Benefit
0	0.00	0.00	0.00
1	117659.00	51878.44	146550.00
2	100159.50	64565.40	126323.30
3	153132.90	108942.20	142458.70
4	130818.50	104731.00	171069.80
5	-39106.10	-69463.40	-37440.60
6	201833.20	143509.30	206010.00

Source: Household Survey, 2016

Table 7 shows that the marginal cost including labour cost of livestock was found to be less than the marginal benefit of each herd except the livestock with total numbers of livestock 3. On the other hand, marginal cost excluding labour cost was also found to be less in comparison to the marginal benefit marginal benefit.

Figure 1: Marginal Cost by Herd Sizes with and without Labour Cost



Source: Household Survey, 2016

Table 8 shows average annual net benefit including and excluding labour cost for different herd size.

According to Table 8, animal husbandry of households having herd with the total numbers of livestock 0, 1, 2 and 3 were in loss in an average but that of households having herd with the total numbers of livestock 4, 5 and 6 were found to be in profit in an average in case of including labour cost. As a result, animal husbandry of whole study area was also found in loss in an average in this case. On the other hand, all the households were found in found in profit in an average in case of excluding labour cost.

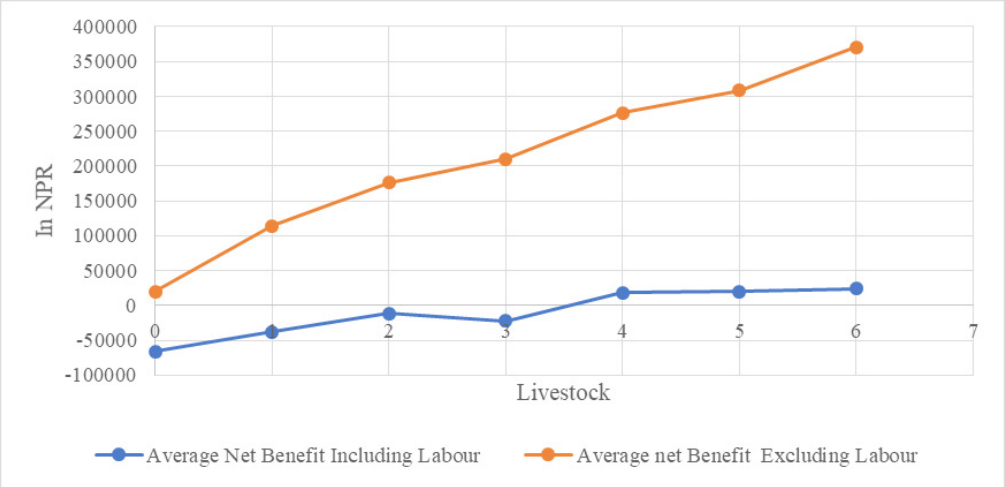
Table 8: Net Benefit and Benefit Cost Ratio (B/C) by Herd Sizes

	Including HH Labour cost		Excluding HH Labour Cost	
Livestock	Average Net Benefit	B/C Ratio	Average net Benefit	B/C Ratio
0	-66416.60	0.51	19847.25	1.40
1	-37525.60	0.85	114518.80	2.13
2	-11361.80	0.97	176276.70	2.06
3	-22036.00	0.96	209793.20	1.76
4	18215.30	1.03	276132.00	1.73
5	19880.80	1.03	308154.80	1.99
6	24057.60	1.03	370655.50	1.82
Study Area	-24173.59	0.93	155193.55	1.93

Source: Household Survey, 2016

The result shows that households having herds with total number of livestock 0, 1, 2 and 3 are in loss with benefit cost ratio (B/C) less than 1 whereas households having herds with total number of livestock 4, 5 and 6 are earning profit with benefit cost ratio (B/C) greater than 1, including labour cost. This result signifies that, at least four numbers of livestock are to be needed for the profitable animal husbandry in the study area. For the whole study area average annual total net benefit and benefit cost ratio (B/C) including labour cost were found NPR -24173.59 and 0.93 respectively. Thus, the animal husbandry in the study area was seen to have loss while including labour cost.

Figure 2: Net Benefit Including and Excluding Labour Cost



Source: Author's estimation based on household survey 2016

The result in Table 8 showed that the increase in annual average total net benefit while excluding labour cost. This is because; the labour cost had highest share among the cost components. The result also reveals that, all the herds could run in profit if labour cost was not taken into account. In addition, the annual average total net benefit NPR 155193.55 and benefit cost ratio (B/C) 1.93 excluding labour cost were found for a household in an average for the whole study area.

Ordinary least square method was employed to determine the factors livestock in herd. Ethnicity, landholding size, maximum education level of family member, net benefit, numbers of economically active family member and remittance earning of the corresponding households were taken as explanatory variables and total numbers of livestock was taken as dependent variable in the study.

Table shows the description of independent and dependent variables.

Table 9: Descriptive Statistics

Variables	Minimum	Maximum	Mean	Std. Deviation
Livestock	0.0	6.0	1.8	1.2
Ethnic Group (Brahmin/Chhetri=1, Other=0)	0.0	1.0	0.3	0.4
Landholding (in Hectare)	0.10	4.07	1.21	0.80
Economically Active Family Member	0.0	9.0	3.5	1.6

Highest Education Level of Family Member (Higher education=1, Other=0)	0.0	1.0	0.6	0.5
Remittance Earning (Earning=1, Not Earning=0)	0.0	1.0	0.2	0.4
Net Benefit (in '0000)	-32.4	55.5	15.5	13.5

Source: Household Survey, 2016

Table 10 shows the correlation matrix between livestock size and different independent variables.

The results of correlation coefficient shows that there is positive and statistically significant relationship between dependent and independent variables except for remittance earning. All the correlation coefficient are statistically significant at 1 % level of significance except remittance.

Table 10: Correlation Matrix

Variables	Livestock	Ethnic Group	Landholding	Economically Active Family Member	Highest Education Level of Family Member	Remittance	Net Benefit
Livestock	1						
Ethnic Group	.281**	1					
Landholding	.389**	0.126	1				
Economically Active Family Member	.333**	0.089	.191*	1			
Highest Education Level of Family Member	.226**	.150*	.196**	.482**	1		
Remittance	0.017	-0.081	-0.119	-0.129	-0.067	1	
Net Benefit	.520**	.316**	.335**	.285**	.304**	-0.133	1

**. Significant at 0.01 and *. Significant at 0.05

Source: Estimated by authors

The output of regression by ordinary least square method is shown in Table 11.

Table 11: Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant Term	0.219	0.206	1.06	0.291
Total Landholding size in Hectare	0.356	0.099	3.603	0.000
Remittance earning	0.409	0.194	2.104	0.037
Net Benefit	0.34	0.006	5.335	0.000
Presence of higher level of education	-0.111	0.175	-0.632	0.528
Ethnic Group (Brahmin/Chhettri)	0.369	0.176	2.100	0.037
Number of Economically active family Member	0.156	0.052	2.988	0.003

R-squared	0.382	Adjusted R-squared	0.361
F-statistic	17.641	Durbin-Watson statistic	1.745
Prob.(F-statistic)	0.000		

Source: Estimated by authors

Here, the results of ordinary least square method of regression shows that determinants like landholding size, presence of remittance earning, net benefit from the livestock rearing, presence of ethnic group Brahmin and Chhettri, and number of economically active family members have positive effect in the size of the livestock acquisition in a family in the study area. The regression coefficients of such variables are also statistically significant at 5 % level of significance. However, the coefficient of presence of higher level of education is negative and statistically insignificant which means that there is no effect of presence of higher level of education on the number of livestock possessed by households.

The regression coefficient shows that 1 unit increase in the quantity of landholding size (in hectare), holding of livestock size will be increased by 0.356 units. Similarly, remittance earning house tend to have 0.40 unit more of the livestock rearing than those who do not earn remittance. 10000 unit increase in net benefit would increase 0.034 unit increase in possessing of livestock. Similarly, Brahmin and Chhettri tend to have 0.37 more unit of livestock holding. And 1 addition of economically active family member give rise the number of livestock holding by 0.16 units.

The R^2 value is 0.38 which means that the 38 percent of the variation is explained by the explanatory variables which is good indicator. The Durbin-Watson test is 1.745 which is greater than critical upper value of DW statistics (1.735) at 1% level of significance,

so there is no autocorrelation in the model. The p-value of the f-statistics is also significant which shows that the overall model is good.

Hence overall demand function can be written as

$Y = 0.22 + 0.37 X_1 + 0.16 X_2 + 0.02 X_3 - 0.11 X_4 + 0.41 X_5 + 0.034 X_6$

5. DISCUSSIONS AND CONCLUSIONS

The result showed animal husbandry is incurring loss on an average if labour cost is included but seen to be profitable if labour cost is excluded. According to the result, as numbers of cow and buffalo increased, animal husbandry seen to have received more benefit amount which is also support by Paudel (2015) and Humagai (2001). Feeding and labour costs were the major cost components which had occupied about 75% out of total cost of the animal husbandry in study area. The studies by Popescu (2014), Singh et al., (2012), Bhari and Yadav(2000), had also shown that the labour and feeding cost as a higher cost bearing items among the cost components. Similarly, Dahal and Dhakal (2016), Lepcha (2006), Adhakari (2000), Tulachan and Neupane (1999) had discussed the close relation between livestock farming and crop farming. The study also showed that manure produced from livestock had vital role in crop farming and crops residue and grains were also good source of feeding for livestock in study area. It was also found that, grass-based feeding is to be promoted rather than the grain-based feeding to reduce cost of animal husbandry. In the same context, Younghang (2013), Singh et al., (2012), and FAO (2010) had also recommended for the promotion of grass-based feeding rather than the grain-based feeding to get more benefit with reducing cost.

Milk produced from cow and buffalo was the major source of income, which is the similar to the findings of Chaudhary and Updhaya (2013), Paudel (2015), Popescau (2014). On the other hand, farmers' benefit from milk had been affected by the rate of price for a fat of milk given to them. Therefore, better pricing policy particularly, incentives to farmers on the basis out output sold could encourage farmers to adopt livestock keeping as a reliable source of income. The same issues had been also raised by Bhari and Yadav (2000), in their study. Socioeconomic factors like ethnicity, economically active family members, remittance earning and net benefits had also affected the livestock size by the households.

Animal husbandry has great importance in Nepalese rural economy and is the source of livelihood and self-employment for Nepalese farmers. The milk and meat items are the major source of income for people and other benefits like sale of ploughing, availability of compost manure for crop cultivation, bio gas production, appreciation of calves and their selling/selling of live animals, availability of nutrients food for

self-consumption etc. can be also obtained from the animal husbandry. But animal husbandry cannot be always beneficial in terms of cost accrued. For the animal husbandry to be financially beneficial, number of livestock must be increased so that the average cost can be minimized.

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